

# ENERGY CALCULATIONS



Fairfax County  
VIRGINIA

## Land Development Services

Department of Public Works and Environmental Services

Hours of Operation: Monday - Thursday: 8:00 a.m. to 4:00 p.m.  
Friday: 9:15 to 4:00 p.m.

Location: **Herrity Building**  
12055 Government Center Parkway  
Fairfax, Virginia 22035  
Telephone: 703-222-0801  
TTY: 703-324-1877

Visit us on the web at: [www.fairfaxcounty.gov/dpwes](http://www.fairfaxcounty.gov/dpwes)



This publication and the calculation methods herein will help you determine if your new house or addition is designed to maximize thermal resistance and minimize air leakage as required by the 2000 International Energy Conservation Code.

### *in this publication:*

<b>CALCULATION METHODS</b> .....	1
<b>TERMINOLOGY</b> .....	1
<b>METHOD 1: TRADE-OFF CALCULATIONS</b> .....	2
<b>METHOD 2: PERCENT GLAZING CALCULATIONS</b> .....	5
<b>METHOD 3: ALTERNATIVE FOR ADDITIONS AND SUNROOMS</b> .....	attached
<b>WORKSHEETS</b> .....	attached

## CALCULATION METHODS

There are three methods to determine if your new home or addition meets the energy requirements. Each require an evaluation of the walls, windows, skylights, etc. which enclose a heated and/or air conditioned space.

- **Method 1: Trade-off Calculations** utilize an exact approach to determine compliance by calculating the house or addition's actual energy loss compared to a maximum allowable loss.
- **Method 2: Percent Glazing Calculations** are a simplified method that measures the percentage of glass or glazing area compared to wall area.
- **Method 3: Alternative for Additions and Sunrooms** provides a simplified method for conditioned floor space less than 500 square feet. See attached worksheet for more information.

The following pages provide detailed instructions on how to complete the corresponding forms for each calculation method.

## TERMINOLOGY

To better understand energy calculations, you should first understand the following terminology:

- **R-value:** a coefficient which measures a material's thermal resistance (the higher the better).
- **U-factor:** a coefficient which measures a material's ability to transfer heat. Applies to glazing assemblies (the lower the better).
- **Glazing:** glass assemblies, such as windows, skylights and glass doors. **Important:** when calculating these areas, use the assembly area NOT the area of the glass only.
- **Sunroom:** A one-story structure added to an existing dwelling with a glazing area in excess of 40 percent of the gross area of the structure's exterior walls and roof.

METHOD 1	TRADE-OFF CALCULATIONS
<b>STEP 1</b>	Detach the Trade-off Worksheet from this package. Complete the information in the lines provided at the top and bottom. <i>House Type</i> and <i>Option(s) Included</i> apply to masterfile drawings only.
<b>STEP 2</b>	<p>The following instructions are for the <b>Walls, Windows and Doors</b> portion of the worksheet: (Tables 1 - 6 can be found on pages 3 - 4 of this package)</p> <ul style="list-style-type: none"> <li>➤ On the <b>PROPOSED</b> side of the worksheet, in the column entitled <b>Insulation R-Value</b>, fill in the R-value of the insulation used in the wall cavity of each different wall type in the building.</li> <li>➤ On the <b>PROPOSED</b> side of the worksheet, in the column entitled <b>U-Factor</b>, fill in the U-factor for the most appropriate construction type chosen from Table 1 for walls, Table 2 for windows and glass doors and Table 3 for doors.</li> </ul> <div data-bbox="310 604 1511 751" style="border: 1px solid black; padding: 5px;"> <p><b>HELPFUL HINT:</b> U-factors manually calculated or obtained from the manufacturer may be substituted for the values found in the tables. <b>Center of glass U-factors are not acceptable.</b> Manufacturer's may provide only R-values. In these cases R-values must be converted into U-factors using the following formula: <math>U\text{-factor} = 1 / R\text{-value}</math>.</p> </div> <ul style="list-style-type: none"> <li>➤ Compute the net area for each wall (total wall area minus the area of windows, doors, etc.) and the total area for each window and door type. On the appropriate rows, input those values in the column entitled Area on the <b>PROPOSED</b> side of the worksheet.</li> <li>➤ On the <b>PROPOSED</b> side of the worksheet, for each row, multiply the values in the U-factor column with the values in the Area column and place the product in the column entitled UA.</li> <li>➤ Add all the individual areas in the Area column on the <b>PROPOSED</b> side of the worksheet and place the sum in the box marked Walls: Total Area. As shown by the arrow, place this value in the box marked Total Area on the <b>REQUIRED</b> side of the worksheet.</li> <li>➤ On the <b>REQUIRED</b> side of the worksheet, multiply the given Required U-factor by the Total Area and place the product in the box marked UA on the <b>REQUIRED</b> side of the worksheet.</li> </ul>
<b>STEP 3</b>	Repeat the procedure described above for the <b>Ceilings, Skylights and Floors Over Outside Air</b> portion of the worksheet. U-factors can be chosen from Table 6 for ceilings, Table 2 for skylights and Table 5 for floors over outside air.
<b>STEP 4</b>	<p>The following instructions are for the <b>Floors and Foundations</b> portion of the worksheet:</p> <ul style="list-style-type: none"> <li>➤ On the <b>PROPOSED</b> side of the worksheet, in the column entitled Insulation R-Value, fill in the R-value of the insulation used in the basement wall, floors over unheated spaces (crawl spaces, garages, etc.) and crawl space walls (for heated crawl spaces only).</li> <li>➤ On the <b>PROPOSED</b> side of the worksheet, in the column entitled U-factor, fill in the U-Factor for the most appropriate construction type chosen from Table 4 for basement and crawl space walls and Table 5 for floors over unheated spaces.</li> <li>➤ Compute the net area for basement walls and total area for floors over unheated space or crawl space walls and input those values in the columns entitled Area on the <b>PROPOSED</b> and <b>REQUIRED</b> side of the worksheet.</li> <li>➤ On the <b>PROPOSED</b> side of the worksheet, for each row, multiply the values in the <b>U-Factor</b> column with the values in the <b>Area</b> column and place the product in the column entitled <b>UA</b>.</li> <li>➤ On the <b>REQUIRED</b> side of the worksheet, multiply the given Required U-Factor by the Area and place the product in the column entitled UA.</li> </ul>
<b>STEP 5</b>	On the <b>PROPOSED</b> side of the worksheet add all the values from all the rows on the

	worksheet in the <b>UA</b> column and place the sum in the box marked <b>Total Proposed UA</b> . Repeat this for the <b>UA</b> column on the <b>REQUIRED</b> side of the worksheet and place the sum in the box marked <b>Total Required UA</b> .
<b>STEP 6</b>	If the <b>Total Proposed UA</b> is less than or equal to the <b>Total Required UA</b> , then the building complies with the energy conservation code. If the proposed value exceeds the required value, then you may need to increase the R-value of the insulation in the walls, provide higher efficiency windows or decrease the window area of the building.

**DON'T FORGET:**

The following areas must be included in **Walls, Windows and Doors**:

- Kneewalls, skylight shaft walls, and dormer walls.
- Walls at the basement level which are greater than 50% above grade.
- Walls between the house and unheated, attached garage.
- Rim joists (the vertical area between floors).
- The triangular gable end walls separating a heated or cooled space, such as in a cathedral ceiling condition or habitable attic space.
- Concrete slabs-on-grade beneath rooms that are heated or cooled must be insulated per Figure 1 on page 6.

**TABLE 1 - EXTERIOR WALLS U-FACTORS**

Construction Type	Sheathing	Cavity Insulation			
		R-11	R-13	R-15	R-19
2x4 or 2x6 studs at 16" or 24" o.c. with an interior finish	<sup>1</sup> / <sub>2</sub> " plywood	0.081	0.071	0.063	0.052
	R-1.5 foam	0.075	0.067	0.060	0.049
	R-2.5 foam	0.070	0.063	0.057	0.047
	R-3.0 foam	0.068	0.061	0.055	0.046
	R-3.6 foam	0.065	0.059	0.053	0.045
	2" plywood, R-1.5 foam	0.072	0.064	0.058	0.048
	2" plywood, R-2.5 foam	0.067	0.060	0.055	0.046
	2" plywood, R-3.0 foam	0.065	0.059	0.053	0.045
	2" plywood, R-3.6 foam	0.063	0.057	0.052	0.044
Plain Concrete, no interior finish <sup>1</sup>	None	0.083	0.073	0.065	0.053
Plain Concrete, with interior finish <sup>1</sup>	None	0.080	0.070	0.063	0.052
Concrete block, no interior finish <sup>1</sup>	None	0.077	0.069	0.062	0.051
Concrete block, with interior finish <sup>1</sup>	None	0.075	0.066	0.060	0.050

<sup>1</sup> Values are based on above grade conditions; for below grade conditions, see Table 4.

**TABLE 2 - WINDOWS, GLASS DOORS AND SKYLIGHTS U-FACTORS**

Element/type	Single-pane	Double-pane
<b>Metal without thermal break</b>		
Window	1.27	0.87
Glass door	1.27	0.87
Skylight	2.02	1.31
<b>Metal with thermal break</b>		
Window	1.08	0.65
Glass door	1.08	0.65
Skylight	1.89	1.11
<b>Metal-clad wood</b>		
Window	0.90	0.57
Glass door	0.90	0.57
Skylight	1.75	1.05
<b>Wood/vinyl</b>		
Window	0.89	0.55
Window; low E	—	0.48
Window; low E, argon gas	—	0.44
Glass door	0.89	0.55
Skylight	1.47	0.84
Glass block assemblies have a U-factor of 0.60		

**TABLE 3 - DOORS U-FACTORS**

Type	without storm door	with storm door
1 <sup>3</sup> / <sub>4</sub> " thick steel door with foam core	0.35	0.21
1 <sup>3</sup> / <sub>4</sub> " thick steel door, no foam core	0.60	0.46
1 <sup>3</sup> / <sub>4</sub> " wood door with 7/16" panels	0.54	0.40
1 <sup>3</sup> / <sub>4</sub> " wood door with hollow core, flush	0.46	0.32
1 <sup>3</sup> / <sub>4</sub> " wood door with 1 <sup>1</sup> / <sub>8</sub> " panels	0.39	0.25
1 <sup>3</sup> / <sub>4</sub> " wood door with solid core, flush	0.40	0.26

**TABLE 4 - BASEMENT & CRAWL SPACE WALL<sup>1</sup> U-FACTORS<sup>2</sup>**

Wall	R-11	R-13	R-15	R-19
Plain concrete with no interior finish	0.085	0.074	0.066	0.053
Plain concrete with interior finish	0.081	0.070	0.064	0.052
Concrete block with no interior finish	0.079	0.070	0.062	0.051
Concrete block with interior finish	0.076	0.066	0.060	0.050

<sup>1</sup> For heated crawl spaces only.

<sup>2</sup> Values are based on below grade conditions; for above grade conditions see Table 1.

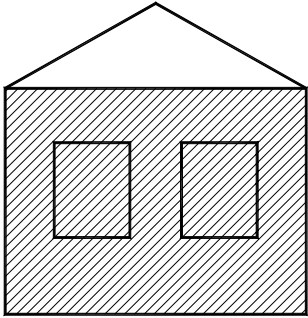
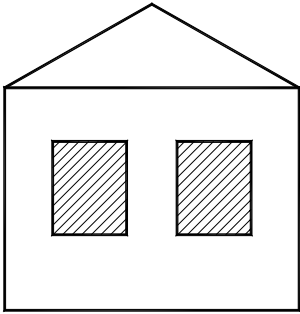
**TABLE 5 - FLOORS**

Construction Type	Composite U-Factor
Joists, subfloor, R-19 insulation	0.05
Joists, subfloor, R-30 insulation	0.03
Joists, subfloor, R-38 insulation	0.025

**TABLE 6 - CEILINGS**

Construction Type	Composite U-Factor
2x rafters, interior finish, R-30 insulation	0.03
2x rafters, interior finish, R-38 insulation	0.025

**METHOD 2****PERCENT GLAZING CALCULATIONS**

<b>STEP 1</b>	Detach the Percent Glazing Worksheet from this package. Complete the information in the lines provided at the top and bottom.
<b>STEP 2</b>	<p>In the area of the worksheet entitled <b>WALL AREA</b>:</p> <ul style="list-style-type: none"><li>➤ Fill in the height and width of each different wall type for all levels and the applicable miscellaneous walls. <b>Do not include basement walls that are greater than 50% below grade.</b></li><li>➤ Multiply the height and width and place the product in the column entitled <b>Area</b>.</li><li>➤ Subtotal the values in the <b>Area</b> columns, follow the arrows to transfer the subtotals to the boxes shown, and calculate the Total Wall Area.</li></ul>  <p><b>WALL AREA</b></p>
<b>STEP 3</b>	<p>In the area of the worksheet entitled <b>GLAZING AREA</b>:</p> <ul style="list-style-type: none"><li>➤ Fill in the height and width of each different window, door, and skylight type for all levels.</li><li>➤ Multiply the height and width and place the product in the column entitled <b>Area</b>.</li><li>➤ Subtotal the values in the <b>Area</b> columns, follow the arrows to transfer the subtotals to the boxes shown, and calculate the Total Glazing Area.</li></ul>  <p><b>GLAZING AREA</b></p>
<b>STEP 4</b>	In the area of the worksheet entitled <b>PERCENT GLAZING</b> , transfer the Total Wall Area and Total Glazing Area to the appropriate labeled boxes and perform the calculation shown to determine the <b>Percent Glazing</b> .
<b>STEP 5</b>	<p>Using Table 7A or 7B and the <b>Percent Glazing</b>, determine the required U-factors and R-values for the locations in the building. Transfer these values to the worksheet in the area entitled <b>REQUIRED U-FACTOR AND R-VALUES</b>.</p> <ul style="list-style-type: none"><li>➤ Use Table 7A for houses and additions with basements.</li><li>➤ Use Table 7B for houses and additions constructed over slabs-on-grade or crawl spaces and with no skylights.</li></ul>

**DON'T FORGET:**

- Do not include basement walls if the basement is NOT heated or cooled. In those cases, the first floor is a floor over an unheated space.
- Doors with glass area greater than 50% of the total door area is considered a glazing area.
- Kneewalls, skylight shaft walls, and dormer walls must be included in wall area.
- Floors over outside air, such as floors supported by posts, overhangs, and floors of bay windows, must be insulated equal to ceilings.
- Walls between the house and garage must be included in wall area.
- Rim joists, the vertical area between floors, is to be included in wall area.
- The triangular gable end walls separating a heated or cooled space, such as in a cathedral ceiling condition or habitable attic space, must be included in wall area.

**TABLE 7A – U-FACTOR AND R-VALUES FOR BUILDINGS WITH BASEMENTS**

Percent glazing (as calculated on worksheet)	Glazing U-factor	Ceiling R-value <sup>3</sup>	Wood framed wall R-value	Floor over unheated space R-value	Concrete/masonry wall R-value <sup>4</sup>		Slab-on-grade R-value <sup>1</sup>	Crawl space wall R-value <sup>2</sup>
					Buried	Above grade		
0 – 8	0.55	30	13	15	8	12	2	12
8 – 12	0.50	38	14	19	9	12	5	16
12 – 15	0.45	38	16	19	9	13	6	17
15 – 18	0.37	38	15	19	9	13	6	16
18 – 20	0.37	38	16	19	9	13	6	16
20 – 25	0.33	38	19	19	9	16	6	17

**TABLE 7B – U-FACTOR AND R-VALUES FOR BUILDINGS WITH NO BASEMENTS**

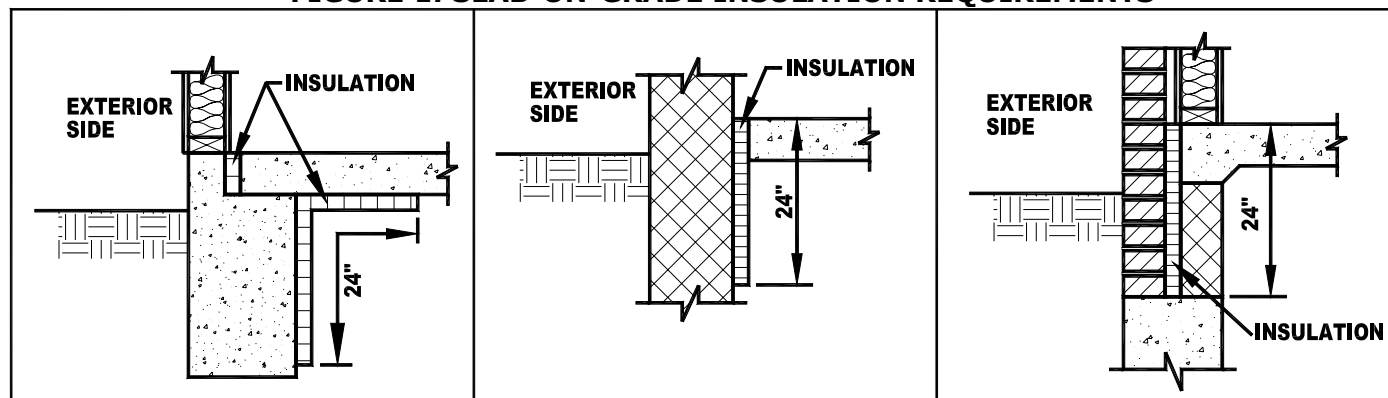
Percent glazing (as calculated on worksheet)	Glazing U-factor	Ceiling R-value <sup>3</sup>	Wood framed wall R-value	Floor over unheated space R-value	Slab-on-grade R-value <sup>1</sup>	Crawl space wall R-value <sup>2</sup>
0 – 8	0.87	30	11	19	4	13
8 – 12	0.67	30	11	19	4	13
12 – 16	0.50	30	11	19	4	13
16 – 20	0.42	30	11	19	4	13
20 – 24	0.36	30	11	19	4	13
24 – 27	0.36	30	13	19	4	13
27 – 32	0.36	30	19	19	4	13

<sup>1</sup> Add R-2 to table value if concrete slab is heated by the embedment of a heating device; see Figure 1 for insulation placement requirements.

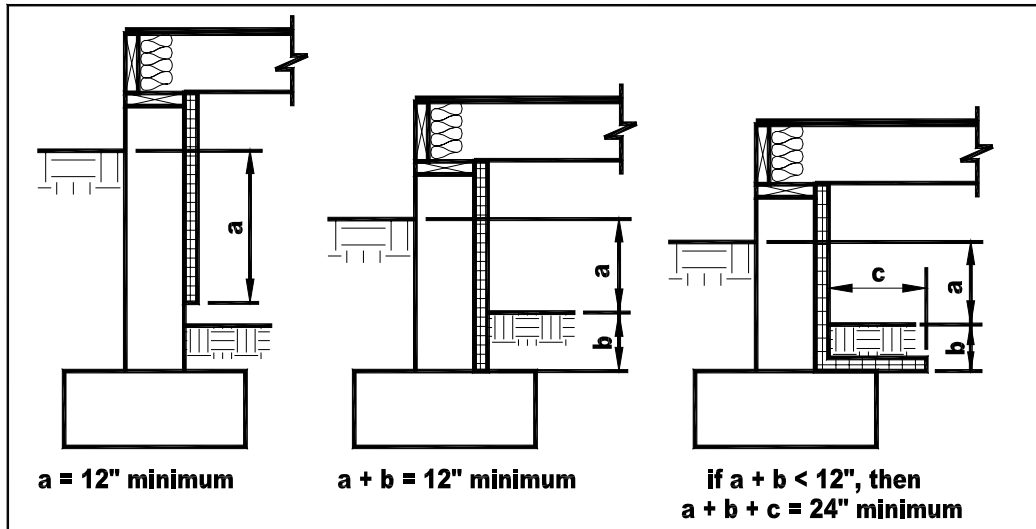
<sup>2</sup> See Figure 2 for placement requirements.

<sup>3</sup> Use this value for floors over outside air such as floors supported by posts, overhangs, and floors of bay windows.

<sup>4</sup> Basement walls are considered above grade when 50% or more of its area is above grade.

**FIGURE 1: SLAB-ON-GRADE INSULATION REQUIREMENTS**

**FIGURE 2: CRAWL SPACE WALL INSULATION REQUIREMENTS**



**This document is available in an alternative format upon request. Please call 703-324-5033 or write DPWES, Room 659, the Herrity Building, 12055 Government Center Parkway, Fairfax, Virginia 22035-5502. Allow seven days for preparation of material.**